



Capelin in the Estuary and Gulf of St. Lawrence

Background

The capelin fishery in the Estuary and Gulf of St. Lawrence expanded quickly with the emergence in the late 1970s of an Asian market for roe-bearing female capelin. From less than 2,000 t back then, annual landings have risen to nearly 10,000 t. Most of the catches are made on the west coast of Newfoundland, where capelin are caught with purse seines. Traps are also used to harvest capelin there, as well as on the Lower North Shore of Quebec, and weirs in the St. Lawrence estuary.

The species geographic range has widened in connection with a decline in water temperatures. Indeed, capelin are now more abundant in the southern Gulf and even occur in the eastern part of the Scotian Shelf. The colder water temperatures are believed to have affected the growth rate of capelin, which would explain the reduction in individual fish size observed in the early 1990s. As a result of the smaller size of the fish caught, the fishing season was cut short in 1994 and the fishery was closed in 1995. Since 1996, however, there has been an increase in the size of the capelin harvested.

At present, capelin abundance in the northern Gulf of St. Lawrence is determined from the capelin by-catches recorded during the annual groundfish survey. After falling earlier, the abundance levels are now of the same order as during the early 1990s. Capelin are preyed on by many species and so represent a key element in the food chain. In light of estimates of capelin consumption by some natural predators, it is clear that the commercial fishery removes only a small proportion of the total biomass.

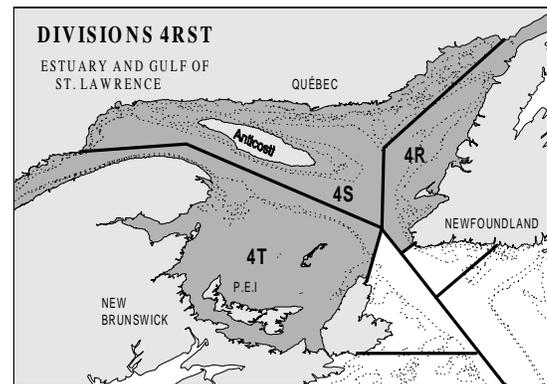


Figure 1. Map of the Gulf of St. Lawrence and NAFO Divisions 4RST.

Biology

Capelin (*Mallotus villosus*) is a small cold-water marine species that has a circumpolar distribution. On the east coast of North America, capelin are found along the Labrador and Newfoundland coasts, on the Grand Banks and in the Estuary and Gulf of St. Lawrence (Figure 1). The species' geographic range now extends to Nova Scotia, and occurrences are occasionally reported as far south as Cape Cod. Although seldom found in Nova Scotia, capelin were abundant in the Bay of Fundy in the 1960s, and have been observed in the eastern part of the Scotian Shelf since the mid-1980s. These two periods of abundance coincided with unusually cold water temperatures.

Capelin spawn around three years of age and may live five or six years. Spawning, which is preceded by a mass migration of capelin toward shore, takes place on the beach or in deeper waters. During beach spawning, the fish literally "roll" on sand or fine gravel, whereas spawning in deeper waters takes place at depths of 30 to 125 m (17-70 fathoms) on the Grand Banks of Newfoundland and possibly in certain areas

of the Estuary and Gulf of St. Lawrence. In Newfoundland, the spawning season generally begins on the south coast around early June and then progresses northwards, occurring around mid-July on the Labrador coast. On the west coast of Newfoundland, as in the Gulf of St. Lawrence, spawning may be sporadic in some locations due to annual fluctuations in water temperature. The beach spawning period lasts about four to six weeks. Elsewhere in the Gulf of St. Lawrence, spawning takes place from west to east. Spawning capelin have been observed as early as mid-April on the north shore of Ile aux Coudres and around mid-July on the Lower North Shore of Quebec. Capelin also spawn in June and July along the Gaspé Peninsula. Many capelin die after spawning, particularly the males, which are injured in repeated matings on the beach. However, a number of them survive and can reproduce several more times. The capelin eggs adhere to the gravel substrate. The incubation period, and the amount of time the young spend on the gravelly bottom, varies with the ambient temperature. Capelin larvae quickly adopt a pelagic lifestyle and remain near the surface until winter. Newly hatched larvae range in size from 3 to 6 mm, and grow to a length of 2 to 4 cm by the beginning of the first winter.

Capelin growth during the first year is identical for males and females; however, males grow more rapidly during the second year (Figure 2). Capelin do most of their growing during the first two years. Factors such as water temperature can affect their growth rate. Most of them reach maturity and begin spawning at age three.

Capelin feed primarily on plankton, and their feeding patterns are seasonal. For example, feeding stops almost completely during spawning, then gradually resumes. Capelin are a very important part of the food chain, since they are the principal food of predators

such as cod and salmon, along with some seabirds and marine mammals whose migrations are linked to the presence of

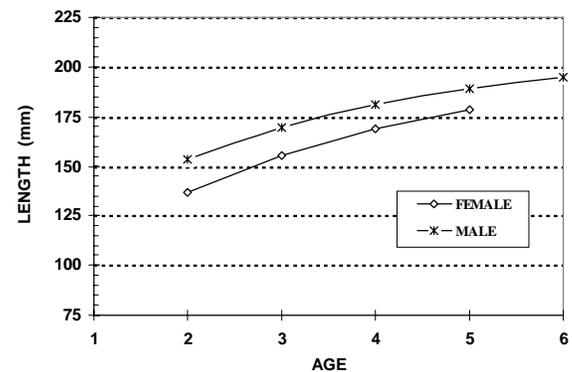


Figure 2. Length (mm) at age in female and male capelin from the Estuary and Gulf of St. Lawrence.

capelin.

Although the population structure of capelin in the Estuary and in the Gulf of St. Lawrence is not clearly defined, the species is managed based on two distinct management units, that is, NAFO divisions 4ST and 4R.

Description of the fishery

Commercially, capelin has not been a much sought-after species in Eastern Canada. Historically, the species has been used to produce farm fertilizer, bait for cod fishing, food for human consumption, and, more recently, fish meal. Because of fluctuating market demand, capelin landings in divisions 4R, 4S and 4T have varied considerably in recent years (Figure 3). Prior to 1977, annual landings were stable at under 2,000 t. The emergence of a Japanese market for roe-bearing females has attracted the attention of Canadian fishers. Japanese demand is responsible for the sharp increase in landings, which stood at about 10,000 t in 1978 and 1979 and also between 1989 and 1993 (Figure 3).

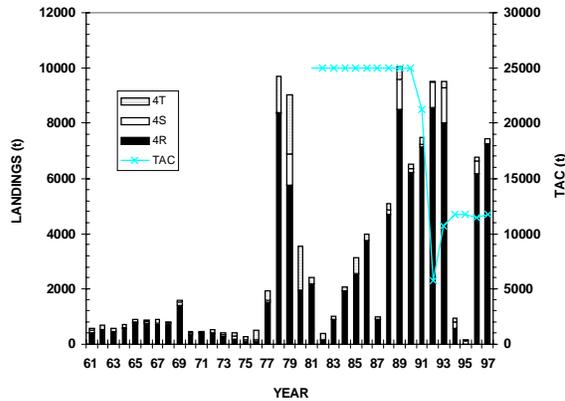


Figure 3. Landings and TAC (t) for capelin in NAFO Divisions 4RST (Estuary and Gulf of St. Lawrence).

The fishing season is short and corresponds to the prespawning period, in the seine fishery, and to the spawning period, in the trap fishery. In both cases, the fishing activities target primarily mature females with the aim of meeting demand for roe capelin. The largest landings in the Gulf of St. Lawrence are nearly always made on the west coast of Newfoundland, that is, in Division 4R (Figures 1 and 3). The TAC for this division is 10,000 t, compared with 1,725 t for divisions 4S and 4T combined. The most intensive fishing in divisions 4R and 4S generally takes place in June and July. In Division 4T, the fishery sometimes begins as early as April. However, it is in May and June that the biggest landings are made there. Purse seines, traps and weirs are used in most catches.

The fishery in 1996 and 1997

Following the shortened fishing season in 1994 and the fishery closure in 1995, capelin landings totalled 6,786 t and 7,451 t in 1996 and 1997 respectively. The closures were prompted by a sharp decrease in the individual fish size, which became noticeable in 1991 (Figure 4) and was observed in all fishing sectors. The situation has returned to normal since 1996, and scientists now believe that the colder water temperatures

caused the growth rate to slow down, producing smaller fish. The market criterion of 50 capelin per kilogram, which ended up being adopted as a management measure, was eliminated in 1996. In exchange, the TACs were reduced by 16% that same year: they dropped from 10,000 t to 8,400 t in Division 4R and from 1,725 t to 1,450 t in divisions 4S and 4T. As in past years, fishers were required to have at least 30% females in their catches in 1996 and 1997.

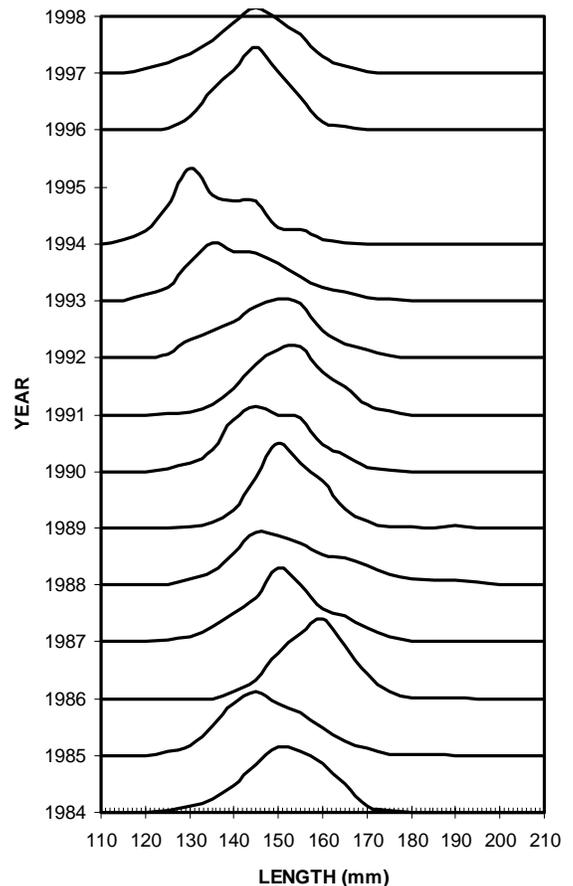


Figure 4. Size composition (expressed as a percentage) of females caught using purse seines in NAFO Division 4R (west coast of Newfoundland).

It is widely recognized that the fishery in divisions 4RST removes only a small portion of the total biomass, compared for example with the consumption estimates for some natural predators of capelin. Accordingly,

the TAC for capelin is set mainly with reference to market supply and demand because the species' availability to the fishery is controlled mainly by environmental factors. The 1997 TACs have been restored to the levels which existed prior to the fishery closures, because they are more in keeping with the market situation.

Capelin by-catches

During the period 1990 to 1997, the catches of several hundred trawlers were sampled under the Observer Program in the Estuary and Gulf of St. Lawrence. This coverage represents up to 9,000 tows/year. The percentage of tows in which capelin were caught varied between 6% and 16% until 1996, and reached 50% in 1997. The majority of observations were made aboard trawlers. The Nordmore grate, which is designed to prevent catches of fish, was gradually introduced aboard shrimpers beginning in 1993. Although this equipment does not completely eliminate capelin by-catches, it at least cuts down on the quantity of fish taken. The main species caught in association with capelin were shrimp, redfish and cod. The largest capelin by-catches occurred in at least five areas of the Estuary and Gulf of St. Lawrence. Those regions are closely linked to sites where shrimp, cod and redfish are caught. In view of the moratoria on cod and redfish fishing, the bulk of capelin by-catches in recent years have been made by shrimpers, whose combined annual by-catches are estimated at 600 t.

Abundance indices

Every year, in August and September a research survey is carried out in the northern Gulf of St. Lawrence to assess the groundfish and shrimp biomass. Since 1990, this survey has been conducted aboard the Alfred Needler research trawler, using a shrimp trawl. The capelin by-catches per

standard tow made during the 1997 cruise are shown in Figure 5. As in previous surveys, the largest capelin catches came from the region between Sept Iles and Anticosti Island, and from the northern part of the Esquiman Channel, on the west coast of Newfoundland. As the mean catches at length per tow indicate, capelin in the year-classes corresponding to a length range of 130 mm to 150 mm were the most abundant in the 1997 survey (Figure 5). Immature fish made up a large portion of the catches.

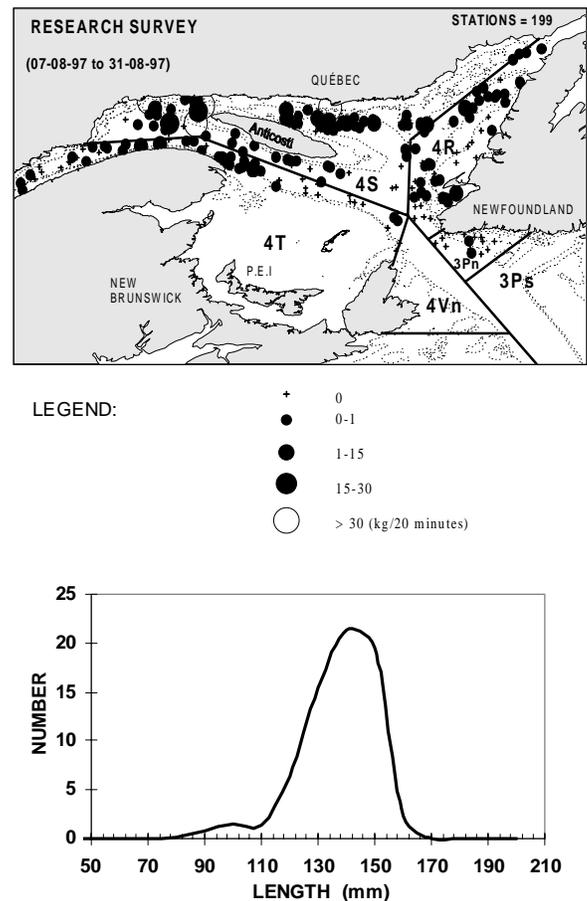


Figure 5. Map of the abundance distribution of capelin (kg / 20-minute tow) and mean catches at length per tow, derived from the 1997 Alfred Needler survey

Mean weights per tow

The mean weights per tow vary greatly. They followed a downward trend between 1990 and 1995 (Figure 6). The highest mean weights were recorded in 1996, and the estimate for 1997, albeit lower than the 1996 value, is close to the levels observed in the early 1990s. Furthermore, during this period, capelin abundance as determined from the survey has always been highest in Division 4S.

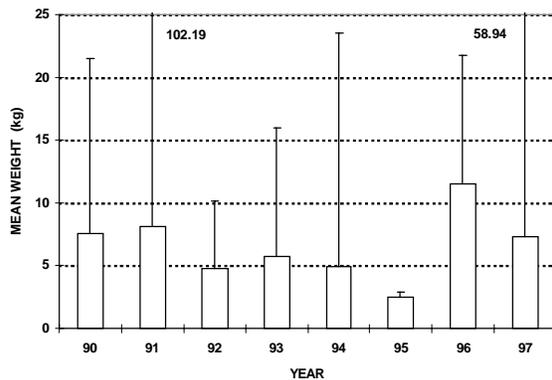


Figure 6. Mean weights (kg) per tow from the Alfred Needler surveys (the vertical lines represent the upper limits of the corresponding weights).

Occurrence Index

The extent of the geographic range of capelin is determined from the occurrence index, which corresponds to the percentage of tows in which capelin are present. The index is adjusted to account for the fact that a different numbers of tows are conducted per unit of sampled area. Between 1990 and 1997, the index showed an uptrend, indicating that the species' geographic range had expanded in the northern Gulf (Figure 7). A substantial expansion was also noted in the southern Gulf, as evidenced by the capelin by-catches recorded during the annual groundfish survey conducted in this area by the Maritimes Region (Figure 8).

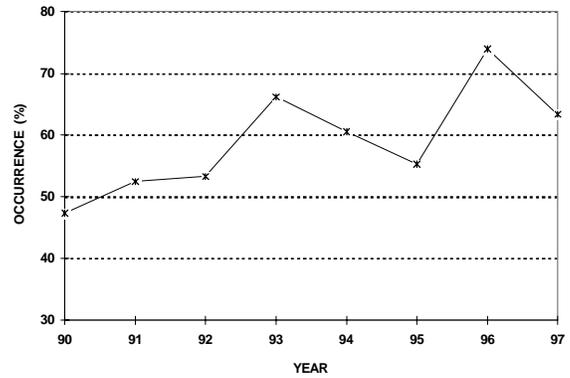


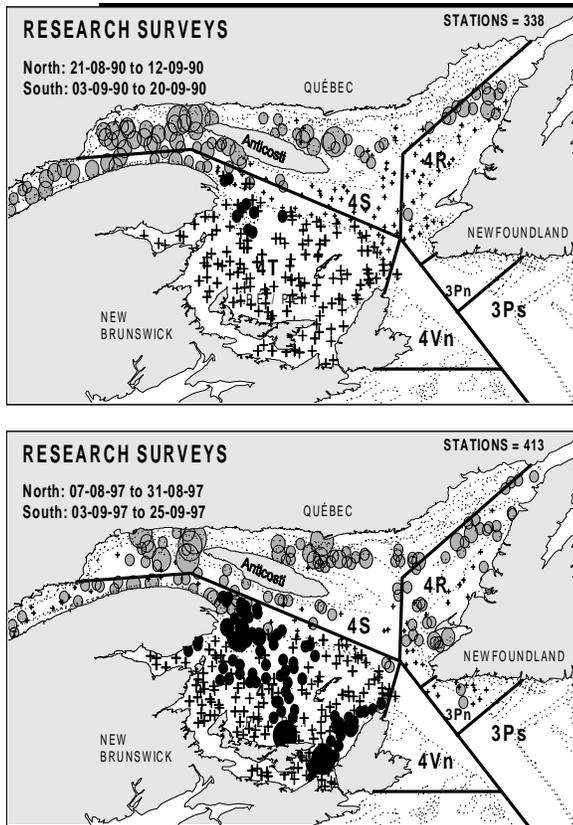
Figure 7. Capelin occurrence from the Alfred Needler surveys since 1990.

Assessment and prognoses

Information from the industry

About 10 capelin fishers from the Lower North Shore of Quebec participated in the Index Fishermen's Program in 1997. They made few landings, not because of a shortage of capelin but rather because of the small size of the fish, the presence of an overly large number of males and the very low prices. The fact that larger capelin were present offshore only, and not near the coast, is another factor mentioned by some fishers.

In the fall of 1996, questionnaires were mailed to some fish processors on the west coast of Newfoundland to seek their viewpoints on capelin biology, the fishery and the state of the resource. In addition to providing interesting input, the respondents agreed overall that capelin abundance was higher at present. Nonetheless, the general consensus was that a conservative approach should be used in managing this stock.



LEGEND:

North	South	
+	+	0
•	•	0-1
●	●	1-15
●	●	15-30
●	●	> 30 (kg/30 minutes)

Figure 8. Annual abundance maps for capelin (kg / 30-minute tow) derived from the groundfish surveys conducted in the northern and southern Gulf of St. Lawrence (note the expansion in the geographic range in the southern Gulf between 1990 and 1997). During the research surveys, gear types with differing degrees of selectivity are used. The tows are distinguished by means of grey and black circles.

Conclusion

The recent declines in water temperature observed in the Gulf of St. Lawrence appear to have had a significant impact on various

aspects of the life cycle of some commercial fish species. In the case of capelin, the drop in water temperature appears to be the main factor behind the species' expanded geographic range in the Gulf and in the eastern part of the Scotian Shelf. The temperature factor may also explain, through its influence on growth rates, the decrease in the individual fish size observed in the early 1990s and the resulting closure of the fishery in 1995.

Capelin have a prominent position in the ecosystem of the Estuary and the Gulf of St. Lawrence as a prey species. Many species of fish, marine mammals and birds are dependent on capelin for their survival. Analyses of catches at length indicate that mortality rates in capelin are very high, primarily due to this predation but also because of the mass mortalities that occur in connection with spawning. Although the level of fishing mortality on the capelin of the Estuary and Gulf cannot be estimated at present, analyses have shown that it is much lower than the natural mortality. Fishing mortality has probably no discernible effects on the population in relation to current catches. However, it is impossible to estimate the effect that a major increase in catches would have on the population and the rest of the ecosystem, since abundance variability in capelin is caused above all by natural factors. Since this species is short-lived, its abundance is subject to sharp fluctuations.

Fishing effort is closely related to the size of the female capelin. The industry's interest in the species increases considerably during years when growth conditions are favourable. Since fishing mortality is not having a discernible effect on the population at present, there are no biological reasons for limiting catches to their present level. However, owing to the species' central role in the ecosystem, any decision to increase

catches or the TAC should be made with caution.

For more information:

Grégoire, F., Morneau, R., Bouchard, H., and J. Landry. 1997. Analyse des captures de capelan (*Mallotus villosus*) associées aux programmes Pêcheurs-Repères du capelan et de la crevette (*Pandalus borealis*). DFO Canadian Stock Assessment Secretariat. Research Document 97/14. 30p.

Grégoire, F., Lévesque, C., and J. Hudon. 1997. Description of the capelin (*Mallotus villosus*) fishery in the Estuary and Gulf of St. Lawrence, 1996. DFO Canadian Stock Assessment Secretariat. Research Document 97/15. 52p.

Grégoire, F., Poirier, G., Chouinard, G., and C. Lévesque. 1997. Capelin (*Mallotus villosus*) by-catches, landings and abundance in the Estuary and Gulf of St. Lawrence. DFO Canadian Stock Assessment Secretariat. Research Document 97/122 (In preparation).

Prepared by:

François Grégoire
Tel. (418) 775-0589
Fax. (418) 775-0740
E-mail: GregoireF@dfo-mpo.gc.ca

Published by

Regional Stock Assessment Office,
Department of Fisheries and Oceans,
Maurice-Lamontagne Institute,
P.O. Box. 1000, Mont-Joli,
Quebec, Canada
G5H 3Z4

Additional copies can be obtained from the above address.

La version française de ce document est disponible à l'adresse ci-dessus.



**Fisheries and Oceans
Canada**
Science

**Pêches et Océans
Canada**
Sciences